

# GemStar Russet: A Potato Variety with High Yield, Good Culinary Quality, Excellent Fresh Market Appearance, and Resistance to Common Scab

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## ABSTRACT

GemStar Russet, derived from the cross Gem Russet x A8341-5, was released in 2004 by the USDA/ARS and the agricultural experiment stations of Idaho, Oregon, and Washington. The foliage of GemStar Russet is dark yellowish-green, spreading, with large leaves and abundant white flowers. The tubers are brown, medium to heavily russeted, oblong, with a slightly prominent eye-brow, white flesh, and indistinct pith. GemStar Russet was compared with Russet Burbank and Russet Norkotah in trials across the Pacific Northwest for yield, quality, and disease response. Except for locations in southern Idaho, in general, GemStar Russet produced slightly lower total yield than Russet Burbank, but much higher U.S. No. 1 yield. When compared with Russet Norkotah, GemStar Russet produced similar total and U.S. No. 1 yields in early harvest trials but higher total and U.S. No. 1 yields in late-harvest trials. When observed for defect problems, GemStar Russet exhibited resistance to second growth, growth cracks, and stem-end discoloration, moderate resistance to blackspot and

shatter bruising, but a high level of susceptibility to hollow heart. In product quality tests, GemStar Russet was rated superior to Russet Burbank for french fry quality and comparable for baked potato quality. GemStar Russet was found to be immune to PVX, resistant to common scab and powdery scab, moderately resistant to Verticillium wilt, tuber net necrosis caused by PLRV, and corky ringspot. It demonstrated susceptibility to late blight, PLRV, dry rot, soft rot, and ringrot and extreme susceptibility to PVY<sup>0</sup>. Biochemical analysis of GemStar Russet tubers showed them to be higher in protein and much higher in vitamin C than those of Russet Burbank or Russet Norkotah. Three-year average for tuber glycoalkaloid concentration was 1.5 mg 100 g<sup>-1</sup>.

## RESUMEN

En el año 2004 el USDA/ARS y las Estaciones Experimentales Agrícolas de Idaho, Oregon y Washington liberaron la variedad GemStar Russet derivada del cruzamiento de Gem Russet x A8341-5. El follaje de GemStar Russet es amarillo verdoso oscuro, extendido, con hojas grandes y abundantes flores blancas. Los tubérculos son pardos, mediana a fuertemente rojizos, oblongos con prominencia del ojo ligeramente pronunciada, pulpa blanca y médula indistinguible. GemStar Russet ha sido comparada con Russet Burbank y Russet

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ADDITIONAL KEY WORDS: *Solanum tuberosum*, variety release, cultivar, disease resistance, breeding

Abbreviation: RHSCC = Royal Horticulture Society Color Chart

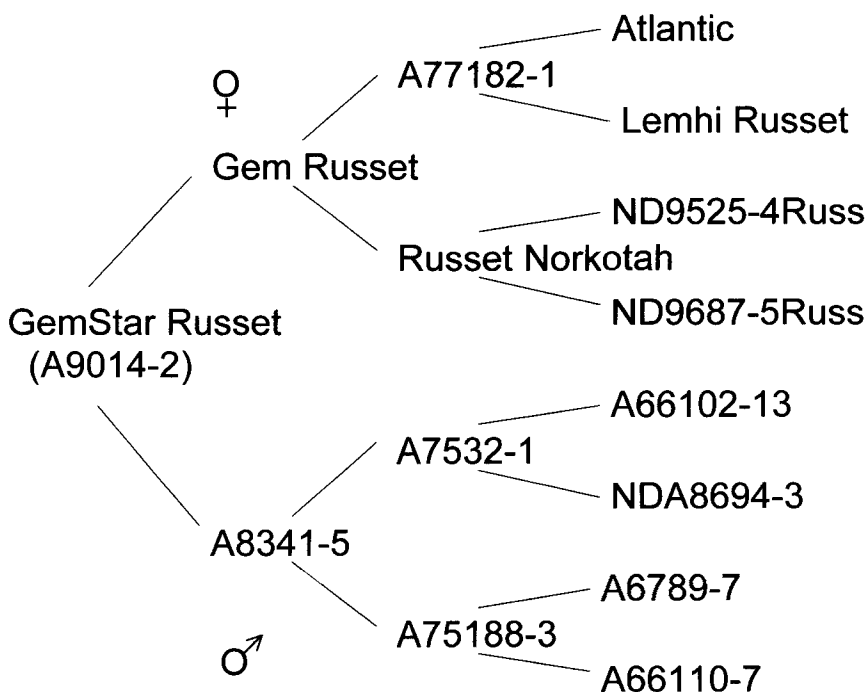
**Norkotah en pruebas realizadas a lo largo del Pacífico nor-occidental para determinar rendimiento, calidad y respuesta a enfermedades. Con excepción de localidades del sur de Idaho, en general, GemStar Russet dio rendimientos totales ligeramente inferiores a Russet Burbank, pero mucho mayor rendimiento de US No 1. Comparado con Russet Norkotah, GemStar Russet produjo un rendimiento total similar y de US No 1 en pruebas de cosecha temprana, pero totales más altos y rendimiento de US No 1 en pruebas de cosecha tardía. Cuando se hicieron observaciones para determinar defectos, GemStar Russet exhibe resistencia a crecimiento secundario, rajaduras de crecimiento y decoloración de la base del tubérculo, resistencia moderada a mancha negra y magulladuras por golpe, pero un alto nivel de susceptibilidad al corazón vacío. En pruebas de calidad del producto GemStar Russet fue calificado como superior a Russet Burbank para papa frita y similar para papa horneada. Se encontró que GemStar Russet es inmune al virus PVX, resistente a la sarna común y sarna polvorienta, moderadamente resistente a la marchitez por *Verticillium*, necrosis reticulada del tubérculo causada por el virus PLRV y mancha corchosa anillada. Demostró susceptibilidad al tizón tardío, PLRV, pudrición seca, pudrición blanda y susceptibilidad extrema a PVY<sup>0</sup>. El análisis bioquímico de los tubérculos de GemStar Russet dio un alto contenido de proteína y mucho más alto de vitamina C que los de Russet Burbank o Russet Norkotah. El promedio de tres años sobre concentración de glicoalcaloides en el tubérculo fue de 1.5mg 100g<sup>-1</sup>.**

## INTRODUCTION

'GemStar Russet', released in 2004 by the agricultural experiment stations of Idaho, Oregon,

and Washington, and by the USDA Agricultural Research Service was first selected at Aberdeen, ID, in 1992. Designated A9014-2, it originated from a 1990 cross of 'Gem Russet' (Love et al. 2002) and A8341-5 (see pedigree in Figure 1). The parent A8341-5 is a breeding clone with long, russet tubers and resistance to blackspot bruise. Prominent varieties included in the parentage (some beyond four generations) are 'Atlantic' (Webb et al. 1978), 'Green Mountain' (Clark and Lombard 1951), 'Lemhi Russet' (Pavek et al. 1981), 'Nooksack' (Hoyman and Holland 1974), 'Norgold Russet' (Johansen 1965), 'Russet Norkotah' (Johansen et al. 1988), and 'Viking' (Johansen et al. 1964). 'Russet Burbank' (Clark and Lombard, 1951) is ancestral to all four grandparents.

GemStar Russet progressed through 12-hill, preliminary, intermediate, and advanced yield trials in Idaho from 1993 to 1997. From 1998 to 2001, it was evaluated in Tri-state and Western Regional Cooperative Trials in Idaho, Oregon, Washington, Colorado, Texas, California, and New Mexico. Prior to release, seed increases and commercial trials were conducted in Idaho, Oregon, and Washington.



**FIGURE 1.**  
Four-generation pedigree of GemStar Russet.

## DESCRIPTION

Plant, flowers, leaf, and tubers of GemStar Russet are shown in Figure 2.

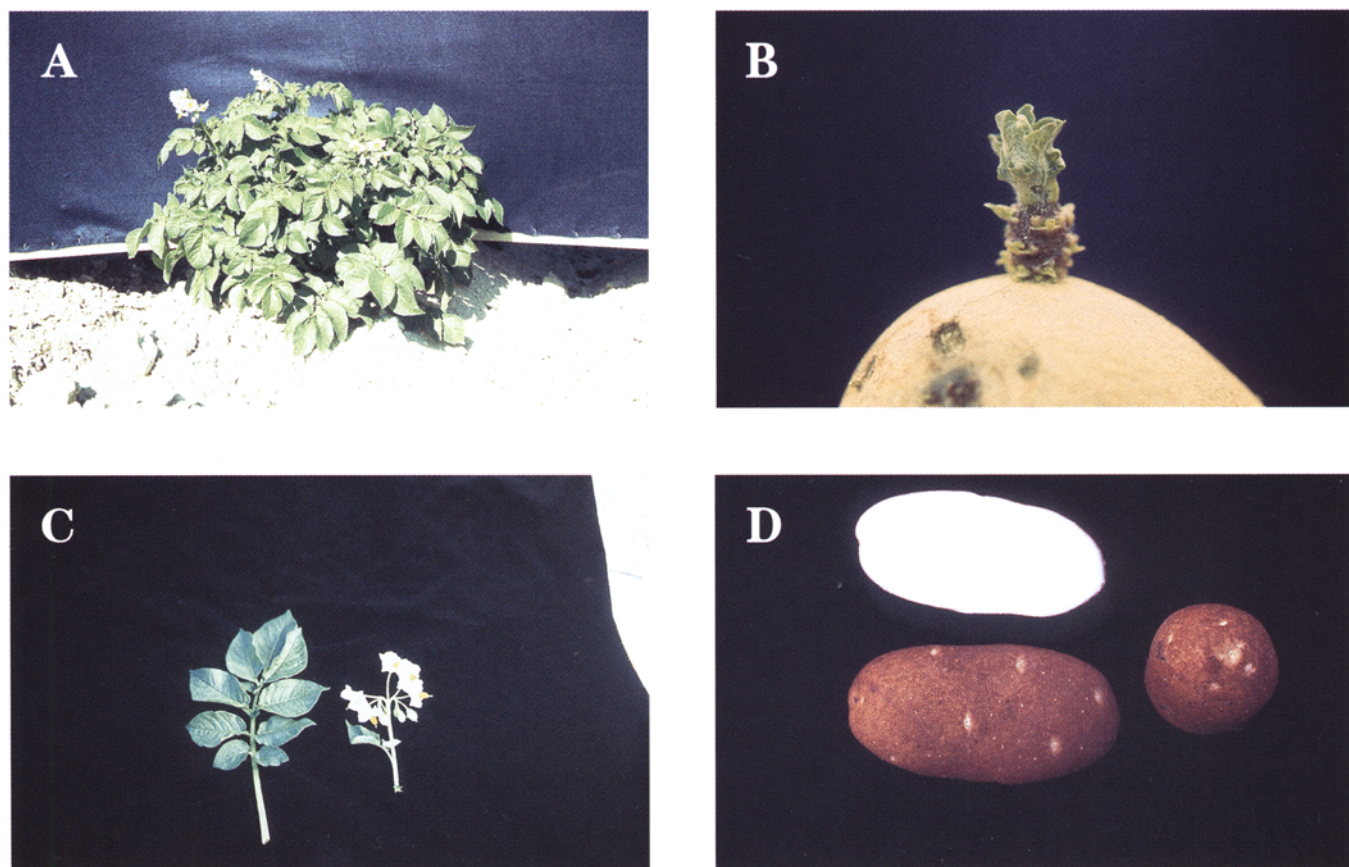
### Plants

*Growth habit:* medium-sized, semi-erect to spreading vine expressing mid-season maturity (110 to 125 days from planting to harvest, compared with 120 to 150 days for Russet Burbank). Vine type is closed with stems barely visible. *Stems:* thick, green with only slight anthocyanin pigmentation, weakly prominent wings ( $\approx 1$  mm wide). *Leaves:* large, broad in outline, dark yellowish-green color (Royal Horticulture Society Color Chart [RHSCC] 143A), with a medium-closed silhouette, and very weak or absent anthocyanin pigmentation on the petioles and midribs. *Terminal leaflets:* broad ovate shape with an acuminate tip and obtuse base; slightly wavy margins; average length 72 mm, width 55 mm (average of 80 mid-canopy

leaflets). *Primary leaflets:* two to five pairs with an average of 3.6 pairs; medium ovate with an acuminate tip and cordate base. *Secondary leaflets:* one to five pairs, average 3.0 pairs. *Tertiary leaflets:* zero to five pairs, average 1.8 pairs. *Stipules:* medium, non-clasping.

### Flowers

*Inflorescences:* abundant, averaging 8.4 florets per inflorescence and 2.9 inflorescences per plant. *Buds:* anthocyanin pigmentation absent; weakly pubescent calyx and pedicel; pedicel articulation prominent; inflorescences occasionally fail to develop, but developed buds seldom abort. *Calyx:* sepals awl-shaped, fused to one-fourth the length of the bud. *Corolla:* pentagonal shape; white (RHSCC 155B) on both inside and outside surfaces; large, averaging 36 mm across. *Anthers:* yellowish-orange color (RHSCC 17A); arranged as a broad cone. *Stigma:* capitate, yellow-green color (RHSCC



**FIGURE 2.** Photographs of GemStar Russet, including plant (A), light sprout (B), flowers and leaf (C), and tubers (D).

146A). *Pollen*: abundant, fertile. *Berries*: spherical, medium green color, low production in the field.

## Tubers

*Tuber size and shape*: oblong; shorter in shape and having a darker brown skin color, and a slightly more prominent eyebrow than Russet Burbank; mean length 117 mm, range 80 to 152 mm; mean width 66 mm, range 50 to 87 mm; mean thickness 57 mm, range 44 to 88 mm (average of 80 tubers weighing 168 to 336 g). *Skin*: brown color (RHSCC 165B); moderately heavy russet pattern; not scaly. *Eyes*: shallow; slightly prominent eyebrow; predominantly apical; moderate number of eyes per tuber, mean 16.6, range 8 to 27. *Flesh*: cream color (RHSCC 158D); slightly prominent pith region. *Dormancy*: medium-long, approximately 130 days when stored at 5 C. *Light sprouts*: medium to dark reddish-brown anthocyanin pigmentation; globose to slightly oblong base; open bud scales; slightly glabrous base with hirsute bud scales.

## CHARACTERISTICS

### Agronomic Performance

In irrigated trials in southern Idaho, GemStar Russet, on average, produced higher total yields than either Russet Burbank or Russet Norkotah (Table 1). These trials were all considered late-harvest (125 to 140 days from planting to harvest). US No 1 yield advantage for GemStar Russet in these trials was pronounced, 38% higher in comparison with Russet Burbank and 34% over Russet Norkotah. GemStar Russet also placed a higher percentage of tubers in the US No 1 grade category than either standard variety.

GemStar Russet was tested for 4 years in both early and late-harvested trials in Idaho, Oregon, and Washington as part of the Tri-state and Western Regional Variety Trials. In the early harvest trials averaged across six locations in the Columbia Basin and eastern Oregon, GemStar Russet produced similar total yields to both Russet Burbank (slightly lower than GemStar) and Russet Norkotah (slightly higher) (Table 2). U.S. No. 1 yields of GemStar Russet were roughly equivalent to those of Rus-

set Norkotah, but considerably higher than those of Russet Burbank (35%). At individual locations, GemStar Russet tended to outyield the other two varieties at Hermiston, OR, and Eltopia, WA. Russet Norkotah tended to outyield GemStar Russet at Othello and Pasco, WA. Russet Burbank had the highest total yield at Malheur, OR, but had the lowest U.S. No. 1 yield. GemStar Russet tended to produce the highest percentage of U.S. No. 1 tubers among the varieties at all locations, except Eltopia, WA, where it was the same as Russet Norkotah.

On average, in late-harvested evaluations, conducted as part of the Western Regional Variety Trials grown at various locations in Idaho, Oregon, and Washington, GemStar Russet substantially outperformed Russet Norkotah for both total and U.S. No. 1 yield (Table 3). In comparison with Russet Burbank, total yield was lower, but U.S. No. 1 yield was markedly greater. As in other trials, GemStar Russet produced a higher percentage of U.S. No. 1 tubers than either of the other varieties. Locations where specific performance deviated from the overall average were Aberdeen, ID, where GemStar Russet produced higher total and U.S. No. 1 yields than either of the other varieties, and Klamath Falls, OR, where Russet Norkotah outperformed GemStar Russet for both total and U.S. No. 1 yield.

As part of the Western Regional Variety Trials, GemStar Russet was evaluated in the Southwestern USA, specifically, California, Colorado, and Texas. Over all locations, GemStar Russet produced similar total yields to Russet Burbank and higher than Russet Norkotah (Table 4). U.S. No. 1 yield and

TABLE 1—Total yield, U.S. No. 1 yield, percentage of No. 1s, tuber specific gravity, and french fry color of GemStar Russet, Russet Burbank, and Russet Norkotah in late harvest trials grown in 11 southern Idaho locations.<sup>1</sup>

Variety	Total Yield (t ha <sup>-1</sup> )	U.S. No. 1 Yield (t ha <sup>-1</sup> )	% U.S. No. 1s	Specific <sup>2</sup> Gravity	Fry Color <sup>3</sup> 4.4 C	Fry Color <sup>3</sup> 7.3 C
GemStar Russet	45.5	37.3	82	1.085	1.9	0.3
Russet Burbank	41.9	23.1	55	1.080	3.5	1.1
Russet Norkotah	32.0	24.5	75	1.070	3.9	1.4

<sup>1</sup>Trial locations included Aberdeen (3 years), Rexburg (2 years), Shelley (3 years), and Kimberly (3 years).

<sup>2</sup>Specific gravity determined using the weight-in-air/weight-in-water method.

<sup>3</sup>French fry color rated using USDA standards, where 0 = light, 4 = dark. Color rated 3 or above is considered unacceptable. Tubers were evaluated after 3 to 6 months storage at 4.4 or 7.3 C.

TABLE 2—Total yield, U.S. No. 1 yield, percentage of U.S. No. 1s, and tuber specific gravity of GemStar Russet, Russet Burbank, and Russet Norkotah in early harvest trials grown in the Columbia Basin and Eastern Oregon, 1998-2001.<sup>1</sup>

Location/Variety	U.S. No. 1			
	Total Yield (t ha <sup>-1</sup> )	Yield (t ha <sup>-1</sup> )	% U.S. No. 1s	Specific <sup>2</sup> Gravity
<b>Hermiston, OR</b>				
GemStar Russet	52.9	45.6	86	1.074
Russet Burbank	50.8	31.4	62	1.075
Russet Norkotah	48.7	39.7	81	1.066
<b>Malheur, OR</b>				
GemStar Russet	48.1	37.3	77	1.088
Russet Burbank	56.7	27.8	49	1.082
Russet Norkotah	49.9	37.3	75	1.075
<b>Othello, WA</b>				
GemStar Russet	60.4	49.5	82	1.076
Russet Burbank	61.9	32.5	52	1.075
Russet Norkotah	74.7	60.5	81	1.073
<b>Eltopia, WA</b>				
GemStar Russet	59.4	50.5	85	1.082
Russet Burbank	47.0	24.4	50	1.082
Russet Norkotah	54.5	46.1	85	1.075
<b>Pasco, WA</b>				
GemStar Russet	50.1	40.3	80	1.082
Russet Burbank	49.4	25.3	51	1.082
Russet Norkotah	59.5	46.1	78	1.077
<b>Overall Mean</b>				
<b>GemStar Russet</b>	<b>53.3</b>	<b>43.9</b>	<b>82</b>	<b>1.081</b>
<b>Russet Burbank</b>	<b>52.8</b>	<b>28.4</b>	<b>54</b>	<b>1.079</b>
<b>Russet Norkotah</b>	<b>53.9</b>	<b>43.0</b>	<b>80</b>	<b>1.072</b>

<sup>1</sup>Trial locations included Hermiston, Oregon (3 years), Malheur County, Oregon (3 years), Othello, Washington, (1 year), Eltopia, Washington (2 years), and Pasco, Washington (1 year).

<sup>2</sup>Specific gravity determined using the weight-in-air/weight-in-water method.

TABLE 3—Total yield, U.S. No. 1 yield, percentage of U.S. No. 1s, and tuber specific gravity of GemStar Russet, Russet Burbank, and Russet Norkotah in late-harvest irrigated trials grown in Idaho, Oregon, and Washington, 1998-2001.<sup>1</sup>

Location/Variety	U.S. No. 1			
	Total Yield (t ha <sup>-1</sup> )	Yield (t ha <sup>-1</sup> )	% U.S. No. 1s	Specific <sup>2</sup> Gravity
<b>Aberdeen, ID</b>				
GemStar Russet	52.7	44.3	84	1.088
Russet Burbank	49.3	29.2	59	1.081
Russet Norkotah	32.7	24.7	75	1.073
<b>Kimberly, ID</b>				
GemStar Russet	48.9	38.7	78	1.084
Russet Burbank	50.9	20.5	39	1.079
Russet Norkotah	35.9	27.6	76	1.068
<b>Othello, WA<sup>3</sup></b>				
GemStar Russet	78.8	67.3	85	1.087
Russet Burbank	84.4	46.6	55	1.082
Russet Norkotah	68.8	55.4	81	1.072
<b>Hermiston, OR</b>				
GemStar Russet	78.3	67.3	86	1.075
Russet Burbank	88.3	51.5	59	1.077
Russet Norkotah	56.9	41.9	73	1.064
<b>Klamath Falls, OR</b>				
GemStar Russet	54.5	46.7	85	1.080
Russet Burbank	60.9	41.2	68	1.085
Russet Norkotah	56.6	49.8	88	1.069
<b>Malheur, OR</b>				
GemStar Russet	50.3	40.7	79	1.089
Russet Burbank	60.2	30.2	50	1.079
Russet Norkotah	47.3	37.8	80	1.073
<b>Overall Mean</b>				
<b>GemStar Russet</b>	<b>60.6</b>	<b>50.8</b>	<b>83</b>	<b>1.084</b>
<b>Russet Burbank</b>	<b>65.7</b>	<b>36.5</b>	<b>55</b>	<b>1.081</b>
<b>Russet Norkotah</b>	<b>49.7</b>	<b>39.5</b>	<b>79</b>	<b>1.070</b>

<sup>1</sup>Data collected from the 1999-2001 Western Regional Potato Variety Trials.

<sup>2</sup>Tuber specific gravity determined using the weight-in-air/weight-in-water method.

<sup>3</sup>The 2000 trial was grown at Warden, WA.

percentage were higher than either standard variety. GemStar Russet performed especially well in the Texas locations where it produced higher yields than either Russet Burbank or Russet Norkotah. In Kern County, CA, Russet Norkotah produced higher total and U.S. No. 1 yields than did GemStar Russet.

### Quality Characteristics

GemStar Russet has demonstrated good resistance to most external and internal defects (Table 5). One obvious exception is hollow heart to which it is susceptible. GemStar Russet has shown a level of resistance to second growth and

growth cracks that is similar to that of Russet Norkotah and much higher than that of Russet Burbank. It is intermediate to the two varieties for response to shatter bruising.

Ratings for blackspot bruise potential using abrasive peel tests have shown GemStar Russet to be moderately resistant to this problem. However, in commercial production situations, GemStar Russet has shown some susceptibility. This may be due more to the large average tuber size than relative tendency for blackening following bruising.

Observations in Idaho trials on stem-end discoloration and heat necrosis have shown very little occurrence of either

TABLE 4—Total yield, U.S. No. 1 yield, percentage of U.S. No. 1s, and tuber specific gravity of GemStar Russet, Russet Burbank, and Russet Norkotah in irrigated trials grown in California, Colorado, and Texas, 1998-2001.<sup>1</sup>

Location/Variety	Total Yield (t ha <sup>-1</sup> )	U.S. No. 1		Specific <sup>2</sup> Gravity
		Yield (t ha <sup>-1</sup> )	% U.S. No. 1s	
Kern Co., CA				
GemStar Russet	33.2	29.9	91	1.088
Russet Burbank	36.8	27.0	73	1.090
Russet Norkotah	39.5	35.8	91	1.084
Tulelake, CA				
GemStar Russet	55.0	47.8	86	1.080
Russet Burbank	62.9	41.8	67	1.083
Russet Norkotah	41.8	33.8	81	1.071
San Luis Valley, CO				
GemStar Russet	49.2	43.9	89	1.093
Russet Burbank	51.7	33.8	65	1.088
Russet Norkotah	43.6	34.4	79	1.077
Springlake, TX				
GemStar Russet	34.2	27.8	82	1.065
Russet Burbank	30.7	6.2	21	1.061
Russet Norkotah	30.8	24.0	77	1.059
Dalhart, TX				
GemStar Russet	26.5	22.7	86	1.069
Russet Burbank	22.7	9.9	43	1.063
Russet Norkotah	25.3	18.6	73	1.062
Overall Mean				
GemStar Russet	39.6	34.4	87	1.079
Russet Burbank	41.0	23.7	54	1.077
Russet Norkotah	36.2	29.3	80	1.071

<sup>1</sup>Data collected from the 1999-2001 Western Regional Potato Variety Trials. Trial years at each location were Kern Co., 2; Tulelake, 3; San Luis Valley, 1; Springlake, 3; and Dalhart, 1.

<sup>2</sup>Tuber specific gravity determined using the weight-in-air/weight-in-water method.

problem. However, some heat necrosis has been observed in Washington State trials during relatively warm growing seasons.

GemStar Russet consistently produced tubers with higher specific gravity than did Russet Burbank and Russet Norkotah in late-harvest, irrigated trials in Idaho (Table 1). In evaluations associated with the Western Regional Trials (Idaho, Washington, and Oregon locations), GemStar Russet tended to produce tubers with slightly higher specific gravity than did Russet Burbank, but markedly higher than Russet Norkotah (Tables 2, 3). In southwestern locations, the specific gravity of GemStar Russet tubers was generally similar to or slightly lower than that of Russet Burbank, but higher than for Russet Norkotah (Table 4).

French fry data generated from southern Idaho trials showed GemStar Russet tubers to have a fairly high level of resistance to cold sweetening (Table 1). French fry color following storage at 4.4 C was well within the range considered acceptable for commercial fry production. The level of resistance to cold sweetening for GemStar Russet is exceptional for a russet-type variety and better than the standard varieties included in the trials.

GemStar Russet tubers were far superior to those of Russet Burbank in comprehensive french fry processing evaluations (Thornton and Knowles 1999-2000; Knowles and Thornton 2001) conducted at Washington State University (Table 6). The most consistent difference between the varieties was for the variables associated with glucose concentration and french fry color. GemStar Russet was ranked first for

TABLE 5—Internal and external defects for GemStar Russet and Russet Burbank tubers grown in 11 trials in southeastern and south-central Idaho.<sup>1</sup>

Variety	Second <sup>2</sup> Growth	Growth <sup>2</sup> Cracks	Shatter <sup>2</sup> Bruise	Blackspot <sup>2</sup> Bruise	Hollow <sup>3</sup> Heart	Stem-end <sup>3</sup> Discoloration	Heat <sup>3</sup> Necrosis
					(%)	(%)	(%)
GemStar Russet	4.9	4.9	3.1	3.4	18	1	0
Russet Burbank	3.4	3.6	2.8	2.9	7	2	1
Russet Norkotah	4.9	5.0	3.6	2.5	5	2	0

<sup>1</sup>Includes trials at Aberdeen (3 years), Kimberly (3 years), Rexburg (2 years), and Shelley (3 years), Idaho conducted from 1999 through 2002.

<sup>2</sup>Second growth, growth cracks, shatter bruise, and blackspot bruise rated 1-5 where 1 = severe, 5 = none. Shatter bruise evaluations were conducted 2 months post-harvest using a bruise chamber designed to mimic rough handling. Blackspot bruise evaluations were conducted using an abrasive peel test and is a measure of blackspot potential (Pavek et al. 1985).

<sup>3</sup>Incidence of hollow heart, stem-end discoloration, and heat necrosis are reported as a percentage of tubers over 336 g with visible symptoms. Hollow heart percentages include both visible hollow cavity and brown center symptoms.

processing quality among nine Western Regional Trial entries in 1999, first among nine entries in 2000, and third among 11 entries in 2001.

Post-storage quality data for GemStar Russet were compiled from 2001 to 2003 at the Kimberly R & E storage facility (Tina Brandt pers comm). Over a 9-month period, when stored at 5.6, 7.3 or 8.9 C, GemStar Russet tubers maintained lower glucose levels, better french fry color, and lower percentage of off-color fried product than tubers of Russet Burbank, 'Alturas', 'Summit Russet', or 'Bannock Russet'. Sucrose concentration of GemStar Russet at harvest was the highest of clones evaluated in these tests (over 0.20% FW), but slowly declined to comparable levels and did not appear to be negatively associated with fry color even after storage at 5.5 C.

In sensory evaluations of baked potatoes conducted for four years (2000 through 2003), GemStar Russet compared favorably with Russet Burbank (Table 7). When evaluated shortly after harvest, analysis of individual 2000 and 2001 tests showed Russet Burbank to be slightly, but statistically superior to GemStar Russet for color (1 year) texture (2 years), flavor (1 year), and overall rating (1 year). When evaluated after 5 months storage, there were no detectable differences in baked quality between the two varieties.

### Disease Reaction

GemStar Russet was evaluated in replicated trials for many of the diseases common in Idaho. Disease ratings for common scab, Verticillium wilt, and early blight were based on 1999-2001 replicated field evaluations conducted at Aberdeen, ID, using naturally occurring inoculum. The protocol for assessing Verticillium wilt was previously described by Corsini et al. (1988). Common scab and early blight evaluations were conducted using three replicate, RCBD plots from which ratings were derived using visual estimations of tuber and leaf area infected, respectively. Late blight field evaluations were conducted at Mount Vernon, WA, as described by Inglis et al. (1996) and in Corvallis, OR. Late blight screening at Corvallis consisted of artificial inoculation of spreader rows between replicated plots with US-8 followed by frequent irrigation. Defoliation and tuber infection were visually rated (Mosley and Yilma pers comm).

GemStar Russet was rated as resistant to common scab (caused by *Streptomyces scabies*) and seldom showed symptoms under normal field conditions in Idaho (Table 8). GemStar Russet also demonstrated moderate resistance to Verticillium wilt (caused by *Verticillium dahliae*), moderate susceptibility to foliar early blight (caused by *Alternaria*

TABLE 6—Results of Washington State University french fry processing evaluations of GemStar Russet and Russet Burbank potatoes.<sup>1</sup>

Variety	Trial Location/Tuber Source									Average
	Washington			Oregon			Idaho			
	1999	2000	2001	1999	2000	2001	1999	2000	2001	
GemStar Russet	29.6	24.8	26.8	20.6	25.5	28.6	31.8	33.5	35.9	28.6
Russet Burbank	23.5	18.6	13.6	7.1	17.3	14.4	22.9	20.3	18.3	17.3

<sup>1</sup>Processing quality rating was developed as a selection index and is derived by adding rating points for important processing variables, including tuber specific gravity, french fry color, taste panel results, wound healing response, and reducing sugar content. A higher score is indicative of better processing quality.

TABLE 7—Sensory evaluations of GemStar Russet and Russet Burbank baked potatoes.<sup>1</sup>

Variety	Pre-storage <sup>2</sup>				Post-storage <sup>3</sup>			
	Color	Texture	Flavor	General	Color	Texture	Flavor	General
GemStar Russet	6.6	5.9	6.0	6.0	6.6	5.8	5.8	5.8
Russet Burbank	6.7	6.1	6.1	6.1	6.5	5.9	5.8	5.9

<sup>1</sup>Tests were conducted over 4 years and consisted of ten sessions, each with 10 to 12 trained panelists. Tubers were rated for color, texture, flavor, and general appeal on a 1-9 scale with 1 = very poor quality, 9 = exceptionally good quality.

<sup>2</sup>Pre-storage evaluations were conducted in early November, approximately 1 month after harvest, and before the storage temperature was brought to its final holding point.

<sup>3</sup>Post-storage evaluations were conducted in March, after 5 to 6 months storage at approximately 4.4 C.

*solani*), moderate resistance to early blight tuber rot, high susceptibility to foliar late blight (caused by *Phytophthora infestans*), but demonstrated slightly more resistance to late blight tuber rot than Russet Burbank (Table 8).

Replicated evaluations of dry rot (caused by *Fusarium* spp.) and soft rot (caused by *Erwinia* spp.) were conducted from 1999 through 2001 using artificial inoculation and incubation techniques. Ratings are based on volume of tubers affected. Inoculation-based dry rot tests at Aberdeen did not indicate unusual susceptibility on the part of GemStar Russet. However, a high level of susceptibility was expressed in inoculated storage trials at the Kimberly, Idaho R & E Center in 2003 (Table 8). GemStar Russet had 93% incidence and 21% decayed tissue caused by *Fusarium*, compared with 80% and 16%, respectively, for Russet Burbank (Brandt et al. unpublished). Confirmation of susceptibility is in the form of occasional dry rot problems in grower storages. Dry rot susceptibility lends itself to the possibility of seed emergence problems with GemStar Russet. Inoculated soft rot tests showed GemStar Russet to be more resistant to soft rot than Russet Burbank.

Evaluations of PLRV, PVY<sup>o</sup>, and PVX were conducted from 1999 to 2003 at Kimberly, ID, using virus-infected spreader rows and releases of green peach aphids as described

by Corsini et al. (1994). In these trials, GemStar Russet showed immunity to PVX. In the same trials, it had response to PLRV similar to that of Russet Burbank (Table 8), both being highly susceptible with strong symptom expression. Net necrosis caused by PLRV was occasionally visible, but more severe in Russet Burbank than in GemStar Russet. GemStar Russet has shown itself to be highly susceptible to PVY<sup>o</sup>. In comparison with Russet Norkotah, tendency for spread within plots and seed fields has been similar or possibly even more rapid. Symptom expression in GemStar Russet is stronger than for Russet Norkotah, but still relatively mild and PVY<sup>o</sup> has only a small impact on vine vigor.

Corky ringspot evaluations were conducted at Egin, ID, Hermiston, OR, and Pasco, WA, as described by Brown et al. (2000) in replicated trials in soil naturally infested with TRV and the stubby root nematode. GemStar Russet was shown to be partially resistant to corky ringspot (Table 8). Necrotic tissue was present in infected tubers, but at a lower rate of incidence and severity than for Russet Burbank and other susceptible clones. Dr. Brown also rated GemStar Russet as being susceptible to root-knot nematode.

GemStar Russet was rated for tuber response to powdery scab (caused by *Spongospora subterranea*) in 2001 in a field near Egin, ID, in replicated plots designed for assessing corky ringspot resistance. GemStar Russet showed no powdery scab tuber lesions while susceptible breeding clones in the same plots were severely infected, in some cases showing almost 100% coverage of the tuber surface.

GemStar Russet response to white mold (caused by *Sclerotinia sclerotiorum*) and rhizoctonia (caused by *Rhizoctonia solani*) were documented in 2003 and 2004 by Dr. Terry Miller of Miller Research in Rupert, ID. Assessments were conducted as four replicate, multiple-row trials. GemStar Russet showed a mixed response to white mold, being less affected than Russet Burbank in 2003 and more affected in 2004. In both cases, reaction was severe enough for GemStar Russet to be considered susceptible to very susceptible. In 2004, 41% of stems were infected on 78% of plants. GemStar Russet's rhizoctonia infection index values were similar to those of Russet Burbank in both years, indicating susceptibility.

Robert Davidson, Colorado State University, completed replicated ringrot evaluations in 2002 to 2003 at

TABLE 8—Summary of disease response ratings from multiple trials conducted in the Northwest for GemStar Russet and Russet Burbank.<sup>1</sup>

Disease	Variety	
	GemStar Russet	Russet Burbank
Common scab ( <i>Streptomyces</i> )	1	1
Verticillium wilt ( <i>Verticillium dahliae</i> )	4	6
Early blight ( <i>Alternaria</i> )		
Foliar response	6	6
Tuber rot	4	3
Late blight ( <i>Phytophthora</i> )		
Foliar response	8	8
Tuber rot	5	6
Dry rot ( <i>Fusarium</i> )	8	6
Soft rot ( <i>Erwinia</i> )	2	6
PVX	1	8
PVY <sup>o</sup>	9	7
PLRV		
Foliar response	9	9
Net necrosis	3	7
Corky ringspot	4	8

<sup>1</sup>Relative disease responses were made based on controlled field trials conducted between 1991 and 1996 and rated 1-9 where 1 = very resistant and 9 = very susceptible. Values were rounded to the nearest integer.

the San Luis Valley research station. GemStar Russet showed early and strong foliage symptoms and typical tuber symptoms when infected with bacterial ringrot (caused by *Clavibacter michiganensis* subsp. *sepedonicus*).

### Biochemical and Nutritional Characteristics

Tubers of GemStar Russet, Russet Burbank, and Russet Norkotah were grown at Aberdeen, ID, for 3 years and subjected to biochemical analysis (Table 9). Compared with Russet Burbank and Russet Norkotah, GemStar tubers consistently had higher total solids, much higher sucrose concentration, much lower glucose (dextrose) concentration, and a higher level of protein. With respect to vitamin C content, GemStar Russet was very high, 33% higher than Russet Burbank and 21% higher than Russet Norkotah. GemStar Russet tubers grown at Aberdeen had an average total glycoalkaloid content of 1.5 mg 100 g<sup>-1</sup>, considerably lower than tubers of Russet Burbank and Russet Norkotah.

### Usage

Based on its excellent appearance, high grade, moderately high tuber solids, very low tuber reducing sugar content, good baking and frying quality, and resistance to most defects, GemStar Russet appears to be suited for fresh market, french fry processing, and dehydration uses. GemStar Russet has not been adequately tested for boiling quality.

## MANAGEMENT OF GEMSTAR RUSSET

Only limited studies on optimal management practices for GemStar Russet have been conducted in southeastern Idaho.

Gemstar Russet has relatively few, apically positioned eyes and avoiding the use of large seed tubers is important for

preventing blind seedpieces. Dry rot potential should be determined on all seed and when appropriate, treated with an effective fungicide. Seed should be planted in soils at or near optimal temperatures to minimize problems with soft rot decay. Soils infested with root-knot nematodes should be fumigated.

Only a single year of N fertilizer and plant population studies has been completed with GemStar Russet. In the N study, the highest total and U.S. No. 1 yields occurred with 200 kg/ha N with one-third applied preplant and the remainder during early tuber bulking. No reliable petiole nitrate-N critical values have been established. In a seed-spacing study, optimal yield and size distribution occurred with seedpieces spaced at 20 to 28 cm when planted in 91-cm-wide rows.

GemStar Russet has not been evaluated for dryland production. However, in irrigation studies, GemStar Russet performed very well in under-irrigated plots (70% of ET replacement). Using limited water, it produced the highest yield of all entries in the trial and maintained good shape and internal quality. This provides some indication that GemStar Russet may be adapted to non-irrigated situations.

The use of management techniques to minimize hollow heart is critical with GemStar Russet. When hollow heart does occur, it is late onset, appearing when the tubers are near full size and bulking rapidly. Practices to reduce hollow heart include using relatively close plant spacing (closer to 20 cm in-row than 28 cm), and proper seed handling and planting procedures to optimize stand. These practices minimize the production of oversized tubers that are more prone to hollow heart. In 2 years of irrigation research, it was found that the most effective measure to reduce hollow heart in GemStar Russet is to limit water availability during the last 3 to 4 weeks of the season. Of the treatments tested, the best procedure was to irrigate normally through mid-bulking, then cut irrigation

TABLE 9—*Biochemical analyses of GemStar Russet, Russet Burbank, and Russet Norkotah tubers.*<sup>1</sup>

Variety	Dry Matter (%)	Sucrose (% FW)	Dextrose (% FW)	Protein (% DW)	Vitamin C (mg 100 g <sup>-1</sup> )	Total Glycoalkaloids (mg 100 g <sup>-1</sup> )
GemStar Russet	24.4	0.44	0.04	6.7	31.3	1.5
Russet Burbank	21.7	0.17	0.08	5.3	21.2	5.7
Russet Norkotah	20.7	0.15	0.12	5.1	24.6	3.0

<sup>1</sup>Tubers sampled from three trials grown at Aberdeen, ID, from 1999 to 2001. Tubers were stored for 1 month at 7.3 to 12.7 C prior to sample preparation. Tubers were cubed, freeze-dried, and ground through a 4-mesh screen prior to analysis.

applications to approximately 75% of ET replacement around the 20th of July, and finally back to 50% of ET replacement on the 10th of August. This treatment caused some loss of yield and may need to be modified to be slightly less severe, but illustrates a possible strategy for using irrigation to minimize hollow heart. In growing areas with climates distinctly different from southeastern Idaho, the timing of irrigation reduction may need to be modified to match the proper growth stage of the crop.

GemStar Russet has shorter tuber dormancy than Russet Burbank. This is somewhat offset by the fact that it can be stored a few degrees colder than Russet Burbank without a negative impact on processing or culinary quality. For processing use it should be stored at 6 to 8 C. In the absence of dry rot problems, it can be stored for up to 12 months for processing or tablestock uses. Sprout inhibition will be required after 2 to 4 months.

## AVAILABILITY

An application for Plant Variety Protection has been filed for GemStar Russet. Persons wishing to procure seed of GemStar Russet for commercial production should contact the Idaho Agricultural Experiment Station at 208-885-7173. Small amounts of seed, for research purposes, can be obtained by contacting Dr. Jeffrey Stark, 208-529-8376 or [jstark@uidaho.edu](mailto:jstark@uidaho.edu).

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